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GLACIAL DRIFT IN ILLINOIS: THICKNESS AND CHARACTER

Kemal Piskin
Robert E. Bergstrom

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ABSTRACT

Unconsolidated deposits—mainly glacial drift—overlie bedrock and form the land surface in most of Illinois. These unconsolidated deposits, consisting of various sediments transported by ice, wind, and water, are parent materials for most Illinois soils, are important sources of building products and ground water, and affect land use, mining, construction, and drilling operations.

As shown by the drift thickness map of the state included in the report, glacial drift ranges from less than a few feet to about 600 feet thick. The thickest drift occurs over major valleys cut into bedrock and, regionally, in the northeastern quarter of the state. The thinnest drift—less than 50 feet thick and intersected by numerous bedrock outcrops—occurs widely in southern and western Illinois.

INTRODUCTION

Most of the Illinois landscape is developed on earth materials deposited by great continental glaciers of the geologically recent Ice Age, by wind, and by streams. These materials, generally unconsolidated, mantle the much older, layered bedrock—mainly shale, limestone, and sandstone—that extends downward to the ancient crystalline basement rocks.

Most of the unconsolidated deposits are the result of glaciation and commonly are called glacial drift or simply drift. They include unsorted, ice-laid rock debris called till, sorted meltwater-laid sand and gravel called outwash, fine-grained sediments laid down in glacial lakes, wind-blown silt called loess, and fine- to coarse-grained sediments of modern streams. They range from 1 or 2 feet to about 600 feet thick.

The most fertile soils of Illinois are developed on the unconsolidated deposits, and most buildings and roads are constructed on them. Besides being im-

portant sources of building materials and ground water, they must be penetrated or removed in any mining operations that go into the bedrock.

Purpose of Study

The purpose of this study is to describe the thickness, distribution, and character of the unconsolidated deposits—essentially the drift—of Illinois. Emphasis is on the physical characteristics of the drift materials, rather than on their age or stratigraphic relations. The basic data for the study of drift thickness are primarily well records from the files of the Illinois State Geological Survey that have been systematically examined by the senior author in connection with a statewide analysis of drift aquifers during the past three years. These records have been provided by drillers, consultants, oil operators, industrial and municipal officials, and cooperating state agencies. Presentations of the stratigraphy, areal distribution, and character of the drift are summarized from other investigators, as cited in the text. Additional details on the drift may be obtained from the frequent references to published reports. The most important of these is Leland Horberg's (1950) report on the bedrock topography of Illinois in which the bedrock surface map of the state is included. This map, reprinted by the Illinois State Geological Survey on a scale of 1:500,000 in 1957, is considered a complement to the drift thickness map (pl. 1) of the present report. The nature of the bedrock formations below the drift is shown in the state geologic map published by the Illinois State Geological Survey (Willman, 1967).

It is anticipated that the information presented in this report has potential application both in regional and site-evaluation problems. This information bears on ground-water exploration and development, drilling procedures, mining operations, construction, and waste disposal, where the following aspects are pertinent: (1) thickness of drift (areas of thick drift or overburden, thin drift, and rock outcrop; depth to bedrock); (2) distribution of drift (location of outwash-filled bedrock valleys, moraines, lake plains, thick loess, and drift borders); and (3) nature of drift (texture of beds, vertical and lateral variability; presence of aquifers, impermeable beds, weathered zones, and loess).

ORIGIN OF DRIFT

For convenience, the terms drift and unconsolidated deposits are used synonymously in this report to refer to the glacial, interglacial, and Recent deposits of the Pleistocene Series (table 1), representing the latest division of geologic time. Technically, the term drift is restricted to the glacial till and interbedded silt, sand, and gravel in the glaciated region and does not include the loess that mantles these deposits nor the Recent alluvium along the stream valleys. Similarly, the unconsolidated deposits include consolidated or cemented sand and gravel in local areas but does not include unconsolidated older formations, such as the Cretaceous and Tertiary deposits of southern and western Illinois.

As suggested by table 1, the Pleistocene history of Illinois, though geologically brief, is complex. Beginning with the Nebraskan glacier that advanced into midwestern United States from an ice center in northern Canada about a million years ago, Illinois has been repeatedly overridden by glaciers. The glaciers, carrying great quantities of rock debris, flowed southward during periods of cold

TABLE 1 - CLASSIFICATION AND CHARACTER OF PLEISTOCENE DEPOSITS (DRIFT) IN ILLINOIS

QUATERNARY SYSTEM	PLEISTOCENE SERIES	STAGE	SUBSTAGE	YEARS BEFORE PRESENT ¹	KINDS OF DEPOSITS	NAMED DEPOSITS AND MORAINES			
		RECENT			Clays, silts, sands, and gravels of present streams; slope wash sediments; lake and beach sediments; dune sands; swamp peat and muck.				
		WISCONSINAN	VALDERAN	5,000 *	Outwash.	Peoria Loess Richland Loess Morton Loess	Lake Border Moraine		
			TWOCREEKAN	11,000 *	Weathering products, not prominent in Illinois.		many named moraines		
			WOODFORDIAN				Tills, in many well developed moraines; loess, outwash, lake sediments.	Shelbyville Moraine	
							22,000 *		
							FARMDALIAN	28,000 *	Silt, muck, and peat.
			ALTONIAN	60,000	Thick, extensive loesses; some tills and outwash.		Roxana Silt, Winnebago Drift		
		SANGAMONIAN			Soil and weathering products; accretion-gley (slope wash) deposits.	Sangamon Soil			
		ILLINOIAN	BUFFALO HART		Tills, some in morainic forms, fossiliferous silts; outwash; mixed ice-contact deposits.	Buffalo Hart Moraine			
			JACKSONVILLE			Roby Silt			
			LIMAN			Jacksonville Moraine			
						Mendon Moraine			
						Petersburg Silt			
		YARMOUTHIAN			Soil and weathering products; accretion-gley (slope wash) deposits.	Yarmouth Soil			
		KANSAN			Till, outwash, slackwater silts.	Sankoty-Mahomet Sand			
		AFTONIAN			Soil and weathering products; accretion-gley (slope wash) deposits.	Afton Soil			
NEBRASKAN		1 million	Till and outwash of uncertain extent.						

¹From radiocarbon dating* or estimation.

and increased precipitation and then melted as the climate warmed. Drift sheets left by the glaciers were weathered during long, warm, interglacial stages. For example, the Illinoian glacier advanced southward to Carbondale (fig. 1), and during the Sangamonian Interglacial Stage that followed, drift from the glacier was weathered as deeply as 15 feet (Horberg, 1953, p. 28).

Wisconsinan drift was deposited on the weathered Illinoian drift in much of Illinois. Later, Recent deposits of diverse origins were distributed over the glacial and interglacial sequence. Logs of representative wells passing through the drift are given in the Appendix.

Types of Deposits

The relations of the various earth materials of the drift to the land surface, glacial features, and bedrock surface are diagrammatically illustrated in figure 2. Glacial deposits can be differentiated into those deposited directly from the ice (till) and those modified by the associated meltwater into glaciofluvial (glacial river) and glaciolacustrine (glacial lake) deposits. Thornburn (1963, p. 16-25) presents a pertinent discussion of the character and origin of the glacial and related deposits of Illinois.

Till

Till is ice-laid debris—a mixture of fragments of all sizes—with rarely any stratification. Commonly, it has a matrix of silt, clay, and sand in which pebbles, cobbles, and sometimes large boulders are imbedded. It occurs in the form of ridges called end moraines and intervening undulatory plains called ground moraines or till plains. The names of moraines, such as Bloomington Moraine, refer to the end moraine. Ground moraines are specially indicated—for example, Bloomington ground moraine. Bloomington drift refers to deposits of both end and ground moraines and all deposits of the glacier that deposited the Bloomington Moraine.

The end moraines record times when the ice front temporarily maintained a fixed position. The moraine built up as rock debris was carried to the melting ice front. The intervening plains between end moraines record times when the front of the glacier melted back.

In composition, the tills of Illinois range from dense clayey silt with few pebbles to gravelly sand containing abundant stratified, water-sorted material. The finer grained tills are much more abundant.

Glaciofluvial Deposits

Glaciofluvial deposits were laid down by meltwater that was discharged along the front of the ice and through crevasses, tunnels, and channels extending back into the ice. The meltwater contained rock debris ranging from clay and rock flour to gravel. In response to changing volume and velocity of flow, the meltwater sorted the particles as it deposited them downstream. Sand and gravel generally were deposited as outwash plains close to the ice front, as along the moraine shown in figure 2, or as valley trains in channels that led meltwater away from the ice. The finer particles were carried farther, often not settling until they reached the quiet water of a lake. Other glaciofluvial deposits were formed as fillings of meltwater channels that flowed on or below the ice (eskers) or as mounds of sediment (kames) where meltwater cascaded into holes in the ice.

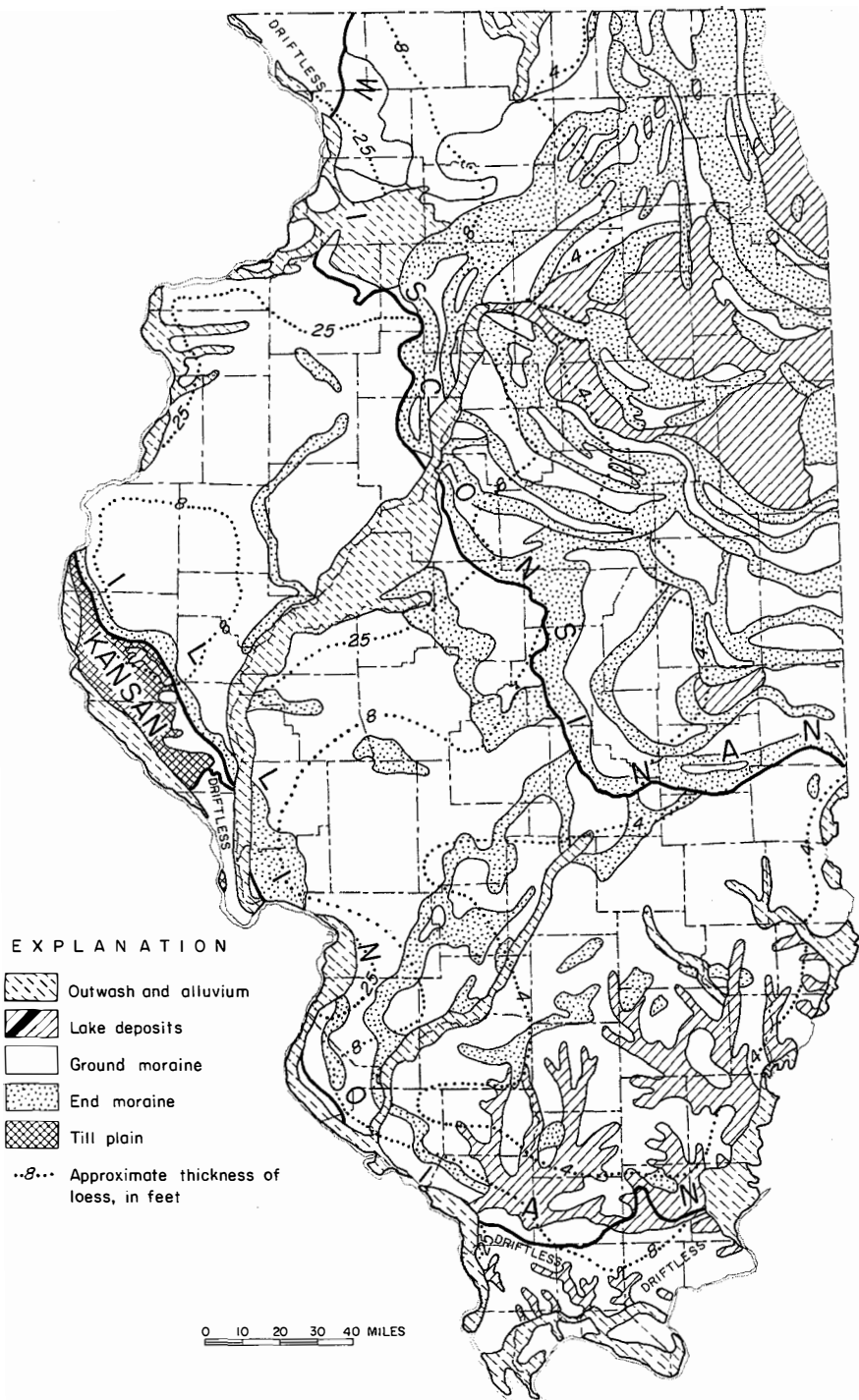


Figure 1 - Glacial geology of Illinois.

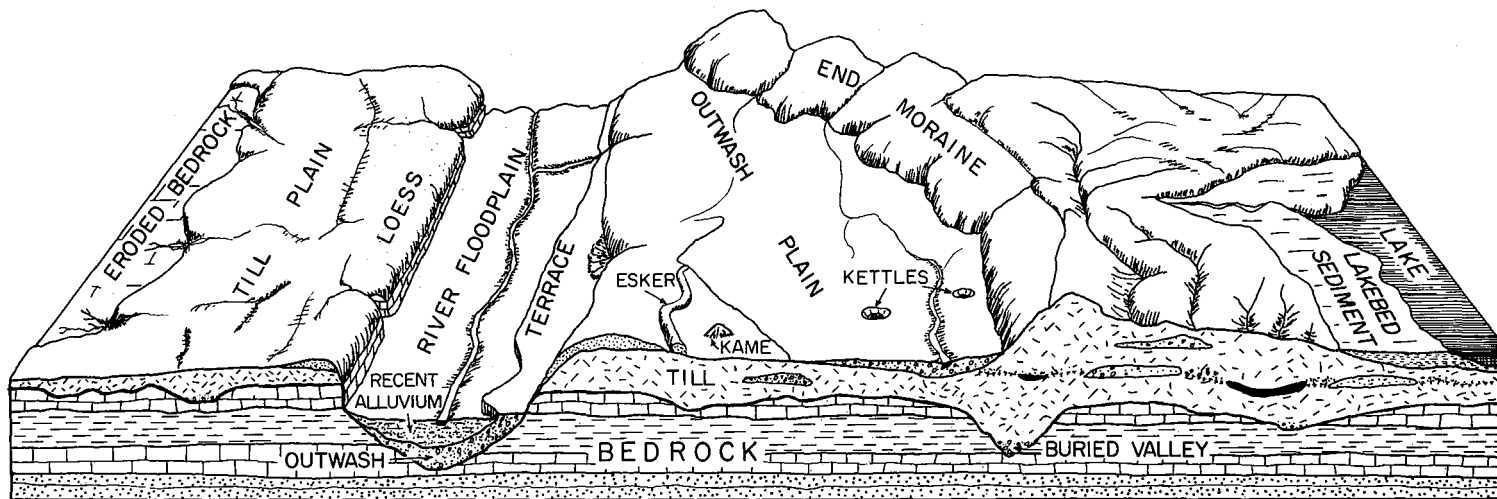


Figure 2 - Block diagram showing relation of glacial and alluvial deposits to land forms and bedrock surface.

The glaciofluvial deposits, especially the valley trains that are extensive along major valleys such as those of the Mississippi, Illinois, Rock, Kaskaskia, and Green Rivers (fig. 1), are important sources of sand and gravel and constitute the most widely used aquifer system in Illinois.

Glaciolacustrine Deposits

Glaciolacustrine deposits consist of well sorted sand and gravel accumulated along beaches of glacial lakes by wave action, inclined sand and gravel beds laid down in deltas, and fine sediment that settled in quiet waters off shore. Many glacial lakes formed behind moraines in the northern half of Illinois (fig. 1), and here lake sediments form a veneer over glacial till.

Wind-Blown Deposits

Wind-blown sediment, chiefly silt, was widely distributed in Illinois during the glacial stages. The source of much of the silt was the river valleys that were partially filled with coarse- to fine-grained glacial outwash (Leighton and Willman, 1950, p. 606). The river flats, kept free of vegetation by frequent glacial flooding, were subject to wind erosion, and great volumes of silt were blown onto the uplands bordering the valleys and formed loess deposits. Because the winds were generally from the northwest, the loess deposits are thicker on uplands east of the main river valleys than on uplands west of the valleys (figs. 1 and 2). In some places, on the east side of wide flats of the Mississippi and Illinois River Valleys, from 50 to almost 100 feet of loess caps the river bluffs (Smith, 1942). The loess becomes finer grained and thins rapidly away from the river valleys but is widespread in the state. Loess deposits occur interbedded with glacial tills and overlying them.

Weathering Products

The effects and products of the interglacial stages are observable in the drift in varying degrees. In some places, humus, peat, wood, or other organic matter occur between drift sheets. In other places, parts or all of a soil or weathering profile are found on a drift sheet, consisting from top downward of the following elements: (1) soil with humus and resistant residual pebbles, (2) clay-enriched subsoil, (3) leached and oxidized drift, (4) oxidized drift, and (5) unaltered drift (Horberg, 1953, p. 9). The profile indicates progressive weathering and alteration of the drift, with oxidation of iron compounds and leaching of carbonates advancing more rapidly than the decomposition of minerals to clays. A widely noted result of weathering of the drift sheets is the occurrence of oxidized brown till over more compact unoxidized blue and gray till.

Another type of material that characterizes the weathered upper part of drift sheets is fine-textured sediment, largely clay, which was washed into shallow initial depressions in the till plain. This type of deposit, called accretion-gley, resembles the clay-enriched zone of a weathering profile but was formed by a different process and does not have great significance as a time indicator (Frye, Willman, and Glass, 1960, p. 19-20; Willman, Glass, and Frye, 1966).

Recent Deposits

Many of the Recent deposits (table 1) of Illinois are a result of the reworking or redistribution of glacial deposits. Silts, sands, and gravels are shifted

about by scour and fill in floodplains (fig. 2). Coarse- to fine-grained sediments are deposited as alluvial fans where tributary streams of relatively high gradients enter the floodplain of a larger stream. Silts are carried by slope wash to lower ground and eventually into ponds, lakes, swamps, and streams. Along Illinois lakes, waves and shore currents are forming beach deposits. The wind has formed dunes in Recent time, particularly south of Lake Michigan.

Organic matter is an additional component of Recent deposition. Peat, marl, and driftwood are common in present-day floodplains. Many swamps in the poorly drained morainal areas and on the lake plain of Lake Michigan fill with water-bearing vegetation and other sediments, forming peat and muck.

The Recent deposits, compared to the glacial deposits, constitute a minor part of the unconsolidated overburden of Illinois.

Rocks Confused with Drift

The place of shale in the geologic sequence in Illinois is sometimes misunderstood. Shale, which crops out or occurs at various depths in wide areas of Illinois, is part of the bedrock rather than part of the drift. However, some drillers have considered it drift and this has resulted in a misunderstanding about the securing of permits and payment of fees to the Department of Mines and Minerals when water wells are to penetrate the subsurface below the drift. In much of Illinois, where shales of the Pennsylvanian System form the uppermost bedrock, the drift is less than 50 feet thick. The geologic map of Illinois, which shows the distribution of bedrock formations below the drift, should be examined in conjunction with the drift thickness map (pl. 1) to determine depth to bedrock and kind of bedrock. Where shales are shown to constitute a large part of the uppermost bedrock, special care is required to distinguish drift from bedrock.

THICKNESS OF DRIFT

Method of Study and Extent of Data

The drift thickness map (pl. 1) is based on three sources of information—well records, drift thickness maps from previous areal investigations, and elevation differences between land surface and mapped bedrock surface in selected areas where well data are sparse or poorly distributed. Altogether, about 8100 drift thickness points were plotted on the work map prior to contouring. The distribution of control points and the areas for which drift thickness maps had previously been prepared are shown in figure 3.

The thickness of drift at about 5600 points, where key well records were available from the files of the Geological Survey, were plotted for a study of glacial aquifers in the state, beginning in 1963. The most reliable records for determination of drift thickness were considered to be the logs of water wells, engineering borings, and coal borings, many of which have drill cuttings that have been interpreted by Survey personnel. Such records were used as a key in interpreting other kinds of records. Some data on drift thickness were obtained from records of oil wells in many localities in the southern part of the state. In some cases, subsurface samples were re-examined to verify the depth of bedrock.

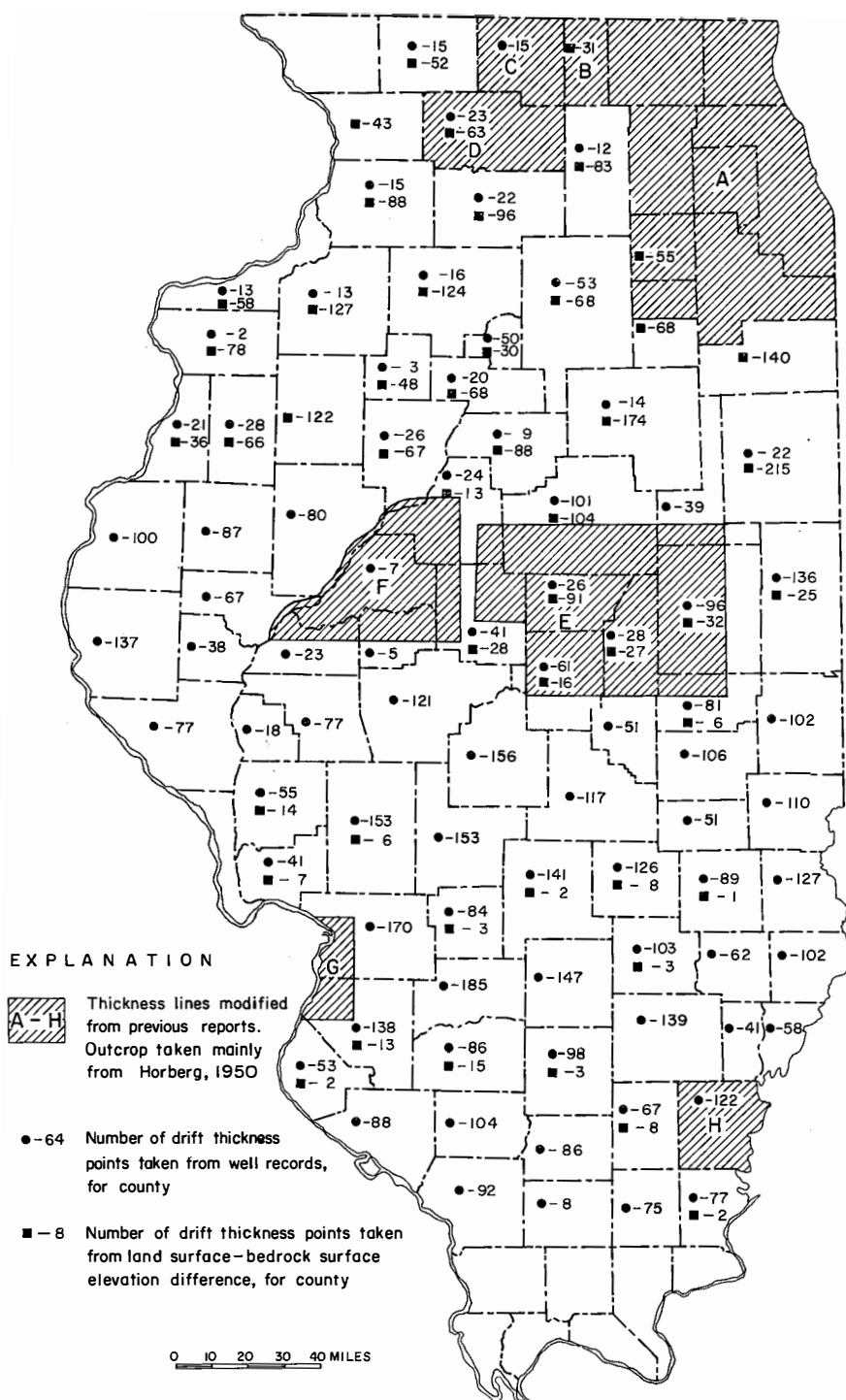


Figure 3 - Sources of data for drift thickness map.

Drift thickness maps for parts of the state have been previously made by Geological Survey personnel, chiefly in connection with ground-water investigations. These maps were incorporated, with modifications as necessary, in plate 1. Some of these maps are presently unpublished.

In area A (fig. 3), drift thickness maps were presented by Suter et al. (1959) for eight counties and by Zeizel et al. (1962) for DuPage County. A revised map (unpublished) of Cook, DuPage, Kane, Lake, McHenry, and Will Counties was also prepared at the Naperville office of the Illinois State Geological Survey for a water resource management study in cooperation with the Northeastern Illinois Metropolitan Area Planning Commission.

A drift thickness map of Boone County (area B) was prepared by John P. Kempton as part of a ground-water investigation now in progress. The adjacent area (C) was studied by James E. Hackett (1960); 600 well records were used, of which about 200 are based on drill samples. Ogle County (D) is under study by James E. Hackett and Richard R. Parizek.

Area E was studied by D. A. Stephenson (1967) relative to ground-water geology of part of the Mahomet Bedrock Valley. His drift thickness map is presented at a 50-foot contour interval and is based largely on water well records. Stephenson's map was modified in the southern portion of McLean County in preparing the map for this report.

A drift thickness map on a 50-foot interval was given for area F by Walker, Bergstrom, and Walton (1965). This map was adapted for the present state map by using only the 50-, 100-, 200-, and 300-foot thickness lines.

In area G, Bergstrom and Walker (1956) presented a drift thickness map at a 20-foot contour interval. Some modifications were made in this map in preparing the present state map. Similarly, some revision of Pryor's (1956b) map of White County (H) was made for the state map.

The other data on drift thickness came from calculated differences in elevation between land surface and mapped bedrock surface. Approximately 2500 thicknesses were calculated in selected areas where well control is sparse. Land surface elevations were taken from U. S. Geological Survey quadrangle topographic maps, and bedrock surface elevations in most of the state were estimated from Horberg's bedrock topography map (1950, 1957). Most of the bedrock outcrop points were also taken from Horberg's map.

In addition to Horberg's bedrock surface map, which compiled data from all reports published before 1950, the following bedrock surface maps were used: an unpublished map of Iroquois, northern Vermilion, and Ford Counties by Keros Cartwright; a map of area E (fig. 3) by Stephenson (1967); and a map of the DeWitt-McLean County area by Heigold, McGinnis, and Howard (1964).

Factors Controlling Drift Thickness

Variations in the thickness of drift are a result of the depositional patterns of the ice, water, and wind that laid down the drift and the subsequent erosion of the drift by ice and running water. In areas that were glaciated several times, including the latest glaciation, the Wisconsinan, thicker drift accumulated. In areas outside the Wisconsinan till plain (fig. 1), the drift is thinner, for there were fewer and older glaciations, and there has been time since the Illinoian ice melted for extensive weathering and erosion to occur. The thickening of the drift from south to north and from west to east is illustrated by the cross sections

(pl. 2) and by the drift thickness map (pl. 1). For example, cross section FF' in plate 2 shows the thin drift across the Illinoian till plain in the southern part of the state in contrast to the thick drift of the Wisconsinan ridged plain in the northern part (cross section BB'). Cross section EE' shows the thin Illinoian drift on the left, the Shelbyville Moraine marking the Wisconsinan front, and the thicker drift below the Wisconsinan ridged plain on the right.

The patterns of drift thickness shown in plate 1 reflect irregularities at the base of the drift (the bedrock surface) or at the top of the drift (present land surface), or both. An intricate erosion surface with valleys and uplands was developed on the uppermost bedrock before and during glacial times, with the result that the drift was deposited on a very uneven floor. The glaciers themselves fashioned many land forms such as end moraines, kames, and eskers that make the upper surface of the drift uneven, and erosion in some areas has produced further irregularities. The cross sections (pl. 2) show that of the two surfaces involved—bedrock and present land surface—the bedrock surface has greater gross relief; the drift mantle has somewhat subdued the older topography. In general, then, drift thickness and the alignment of thickness lines reflect mainly the bedrock topography.

Drift in Bedrock Valleys

Horberg's report (1950) on the bedrock topography of Illinois delineated the main valleys and upland surfaces and described the character of the drift fill in the valleys. The bedrock valley systems shown in figure 4 are taken basically from Horberg's report.

Comparison of plate 1 (generalized in fig. 5) with figure 4 and the cross sections shows that the areas of thickest drift correspond with the Princeton, Pawpaw, Troy, Middle Illinois, Mackinaw, Danvers, and Mahomet Bedrock Valleys and their tributaries. With the exception of the Middle Illinois, these valleys are almost completely buried by glacial drift and do not conform with present drainage lines. Where moraines (fig. 1) cross or are aligned with buried valleys, the drift is further thickened. Drift thickness in the major buried bedrock valleys and related present valleys and lowlands is summarized below.

Princeton Bedrock Valley

The Princeton Bedrock Valley carried the Ancient Mississippi River eastward to the valley of the present Illinois River before being closed by drift deposited in Wisconsinan time, when the Mississippi assumed its present more westerly course. The valley underlies the Green River Lowland on the west and the Wisconsinan morainic upland on the east (CC', pl. 2). The valley is about 65 miles long and 3 to 7 miles wide.

In the Green River Lowland, the drift averages 160 feet thick, but over the deep bedrock channel, it probably attains a thickness of 300 feet. At Erie, a mile south of the deep channel, bedrock was reached at 167 feet. Where the bedrock valley passes under the Bloomington and Cropsey Moraines, in central Bureau County, the drift averages 300 feet thick and attains a maximum thickness of over 400 feet. A well at Princeton hit bedrock at 372 feet.

Upper Rock River-Troy-Pawpaw Bedrock Valleys

The Upper Rock River Bedrock Valley includes the bedrock valley system still followed by present drainage north of the White Rock Moraine. From the

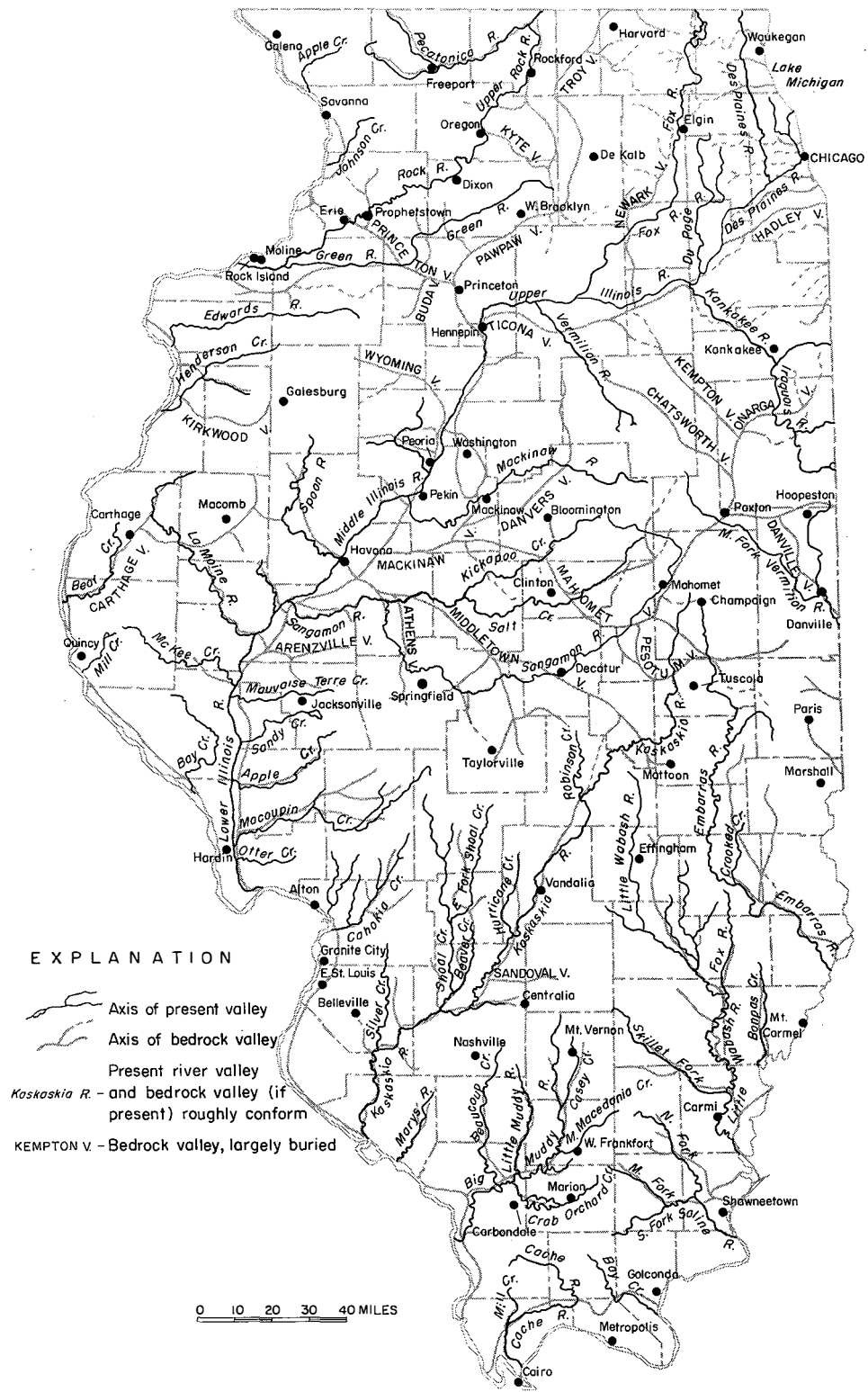


Figure 4 - Axes of present and bedrock valleys.

point in southeastern Ogle County where the bedrock valley passes southward under the Bloomington Moraine, it is known as Pawpaw Bedrock Valley. Troy Bedrock Valley, in Boone and DeKalb Counties (AA', pl. 2), parallels the Upper Rock and Pawpaw Valleys, then joins Pawpaw Valley in southeastern Lee County. Pawpaw Valley joins Princeton Valley in Bureau County, in the vicinity of Princeton.

The Upper Rock River Bedrock Valley in Illinois is nearly 45 miles long and from $1\frac{1}{2}$ to $3\frac{1}{2}$ miles wide. The thickness of the drift ranges from 150 to 400 feet and averages 200 feet. At Rockford, wells commonly reach bedrock at depths of more than 200 feet. In Pecatonica River Valley, the drift averages 125 feet thick and attains a maximum of more than 250 feet.

Pawpaw Bedrock Valley is about 45 miles long and up to 4 miles wide. The drift ranges from 350 to 550 feet thick (BB', pl. 2) and in a few places probably approaches 600 feet. The thickest drift in the state is found in southeastern Lee County where the Bloomington and Cropsey Moraines cross Pawpaw Bedrock Valley. At Pawpaw, bedrock is reached at a depth of about 450 feet. The nature of the drift in the lower Pawpaw Valley is illustrated by the log of well 6 (Appendix).

Troy Bedrock Valley is completely filled by drift, except for a few miles in southwestern Boone and southeastern Winnebago Counties where it is occupied by the Kishwaukee River. The valley is 60 miles long and $1\frac{1}{2}$ to 3 miles wide. In southern DeKalb County, the drift exceeds 400 feet thick, and in northeastern Boone and northwestern McHenry Counties, it may be 500 feet thick. A recent core boring drilled for the Northeastern Illinois Metropolitan Area Planning Commission in sec. 7, T. 46 N., R. 5 E., in northwestern McHenry County (Lund, 1965, p. 43-52), passed through a typical Wisconsinian till and gravel sequence (well 7, Appendix) and reached bedrock at about 474 feet.

Ticona Bedrock Valley

Ticona Bedrock Valley joins Princeton Bedrock Valley just east of Hennepin, Putnam County, and is entirely buried eastward to the western boundary of Grundy County. The drift attains a thickness of more than 200 feet (BB', pl. 2).

Newark Bedrock Valley

Newark Bedrock Valley, of Kane, Kendall, and Grundy Counties, may have carried the headwaters of Kempton Bedrock Valley of Livingston and Ford Counties. Newark Valley is about 1 mile wide and is entirely buried by drift ranging from 50 to 250 feet thick (BB, pl. 2).

Illinois Valley

From Hennepin southward, the Illinois River flows in an alluviated bedrock valley that is composed of segments of different ages and has varying thicknesses of fill. The Middle Illinois Bedrock Valley, between Hennepin and Peoria, is about 35 miles long and about 7 miles wide, whereas the present valley is about 4 miles wide (CC, pl. 2). The western bluff of the river coincides with the western edge of the bedrock valley. Drift beneath the river floodplain attains a maximum thickness of 200 feet, whereas beneath the upland, over the bedrock channel east of the river, the drift is up to 350 feet thick.

Just north of Peoria, the wide, deep bedrock valley angles southeast beneath the upland, where it is called Mackinaw Bedrock Valley. The Illinois River continues south, first passing through a narrow, shallow bedrock gorge between

Peoria and East Peoria and then following a slightly wider bedrock channel (Pekin-Sankoty) that diverges from the main bedrock valley just north of Peoria and passes under west Peoria and past Pekin to the Havana Lowland. The channel is 2 to 3 miles wide, in places underlies the upland, and in places underlies the present floodplain.

Within the narrow gorge between Peoria and East Peoria, the drift-outwash and Recent alluvium—attains a thickness of 100 feet. Over the Pekin-Sankoty Bedrock Channel, glacial deposits may reach a thickness of 400 feet under the present upland and are about 120 feet thick below the present floodplain.

South of Pekin, the Illinois River crosses the western part of a wide lowland. Here the drift ranges from less than 50 feet thick beneath the floodplain west of the river to more than 200 feet east of the river where river terraces with sand dunes overlie the deepest part of the bedrock valley (DD', pl. 2). Where the Illinoian and Wisconsinan drift uplands, containing loess deposits, overlie the deep part of the bedrock valley, the drift reaches 400 feet in thickness.

The Illinois River Bedrock Valley becomes progressively narrower south of the Havana Lowland, from 6 miles wide at Beardstown to slightly over 2 miles wide at the mouth of the river. The average thickness of the fill in the valley is 125 feet and the maximum is about 175 feet.

Mackinaw Bedrock Valley

The Mackinaw Bedrock Valley is 5 to 10 miles wide and extends from western Woodford County to southern Tazewell County, where it joins the Mahomet Bedrock Valley. Between 300 and 500 feet of drift overlie the valley. At Washington, a well over the valley reached bedrock at 370 feet. At Mackinaw, a well reached bedrock at 380 feet.

Danvers Bedrock Valley

The Danvers Bedrock Valley, an east-side tributary of Mackinaw Valley, is from 3 to 9 miles wide in Livingston, Woodford, and Tazewell Counties and is overlain by 100 to more than 400 feet of drift.

Mahomet Bedrock Valley

The Mahomet Bedrock Valley and its tributaries are well defined by belts of thick drift in east-central Illinois. Originally described by Horberg (1945, 1950), the Mahomet Valley enters Illinois at the northeastern corner of Vermilion County and joins the Mackinaw Bedrock Valley in southern Tazewell County. The axes of the valley and its tributaries, shown in figure 4, are essentially from Horberg (1950, pl. 2), with modifications by Cartwright (unpublished), Heigold, McGinnis, and Howard (1964), and Stephenson (1967). The chief modifications are the movement of the valley axis eastward 5 or 6 miles in DeWitt County and the addition of a tributary (Harris Bedrock Valley) across DeWitt and northern Piatt Counties. The modifications are based on additional subsurface data and on seismic investigations.

The Mahomet Valley is about 135 miles long in Illinois, and the belt of thick drift (300 feet or more) over the valley is at least 3 miles wide and locally up to 10 miles wide (BB', EE, pl. 2). The maximum thickness of drift penetrated in a well to date is 447 feet at Paxton, Ford County. Thick drift (over 400 feet) is found in the vicinities of Hoopeston and Rankin in Vermilion County, Clinton in DeWitt County, and Mahomet in Champaign County, where moraines cross the bedrock

valley. In the eastern part of the valley, the drift may attain a thickness of 500 feet. Typical deposits of the Mahomet Valley are illustrated by the log of well 4 (Appendix).

Kempton-Chatsworth-Onarga Bedrock Valleys

The Kempton-Chatsworth-Onarga Bedrock Valleys, a tributary system of the Mahomet, localize belts of thicker drift in Iroquois, northern Ford, and eastern Livingston Counties. At the junction of the Kempton and Mahomet Valleys, the drift is more than 400 feet thick, whereas up the three tributaries, the drift is more than 200 feet thick.

Middletown Bedrock Valley

The position of the lower course of Middletown Valley (fig. 4) is after Walker, Bergstrom, and Walton (1965) rather than Horberg. It and a tributary, Athens Bedrock Valley, are sites of thicker drift in Menard, Logan, Sangamon, Christian, Macon, and Moultrie Counties (DD', pl. 2). Wells at Middletown, in western Logan County, are about 150 feet deep and are finished in sand and gravel on the western flank of the valley. Farther east, over the deep channel, the drift attains a thickness of more than 200 feet.

Present Drainages

The Mississippi, Kaskaskia, Big Muddy, Wabash, Embarras, Little Wabash, Ohio, and Cache River Valleys generally contain thicker unconsolidated deposits than the regions they cross.

Deposits in the bedrock channel of Mississippi Valley north of Princeton Valley range in thickness from about 140 feet to possibly over 300 feet, the average being over 150 feet. A thickness of 340 feet is reported by Horberg (1950, p. 46) for a well at Dubuque, Iowa, across the river from the northwestern corner of Illinois. In the Mississippi Valley, between Princeton Valley and the mouth of the Illinois River, the deposits have an average thickness of 150 feet and locally are more than 200 feet thick. In two places (fig. 1), the river is directly against the bluff, and there is essentially no floodplain in Illinois. The fill in the Mississippi Valley south of the Illinois River ranges in thickness from 125 feet to over 170 feet. In the American Bottoms, in Madison County, the valley fill exceeds 170 feet thick below a terrace at Wood River (FF, pl. 2) (Bergstrom and Walker, 1956).

Deposits in the Kaskaskia and Big Muddy Valleys reach thicknesses of 125 feet (FF, pl. 2). The bedrock valleys do not conform to the present valleys in all courses of the streams.

Deposits in the Wabash Valley are 100 to 150 feet thick. In a long stretch of the Embarras and in portions of the Little Wabash River Valleys, they are more than 100 feet thick.

Approximately 25 miles south of the Illinoian drift border, the Cache Bedrock Valley, a former course of the Ohio River, contains as much as 160 feet of pebbly sand. The valley fill of the Ohio and Mississippi Rivers at the very southern tip of the state is as much as 250 feet thick (Pryor and Ross, 1962). The alluvial deposits in the Black Bottom area of the Ohio River floodplain in the southeastern part of the state are up to 100 feet thick (Ross, 1964).

Drift on Bedrock Uplands

The drift on the bedrock upland in wide stretches of northwestern, western, and southern Illinois is less than 50 feet thick. In many places, on hillsides, in river bluffs, or in tributary creek beds or ravines, the drift has been removed by erosion, exposing bedrock. The areas of thin, eroded drift of western and southern Illinois (fig. 5) closely correspond with the Illinoian drift plain (fig. 1).

Within the Wisconsin drift plain, thin eroded drift overlies the bedrock uplands in northwestern Illinois and in LaSalle, Livingston, Kendall, Grundy, Will, and Kankakee Counties. Fairly thick drift, commonly 100 feet or more, overlies the bedrock uplands in east-central and northeastern Illinois. As shown by the cross sections (pl. 2), drift more than 100 feet thick over bedrock upland usually occurs only where moraines are present.

Surficial Features

In addition to reflecting features of the bedrock surface, the drift thickness map shows some of the moraines, terraces, dunes, and many of the drainage lines of the present landscape. The thickening of the drift in excess of 50 feet in east-central Illinois marks the Shelbyville Moraine. The Valparaiso and Lake Border Moraines in northeastern Illinois are marked by belts of drift from 100 to more than 200 feet thick. Small, closed, irregular thickness lines, showing 200 and 300 feet of drift in Mason County, reflect dune modified terraces and drift plain of the Havana Lowland. If data were available, probably additional closed contours showing local thickening of drift would be shown adjacent to the Illinois and Mississippi Valleys where thick deposits of loess occur.

The present major drainages—such as the Mississippi and lower Illinois Rivers—are accentuated by bands of rock outcrops along linear belts of thicker drift. Many of the smaller tributary streams are marked by dendritic belts of rock outcrop, showing that they are flowing on rock with essentially no fill. The course of the lower Des Plaines River is marked in this fashion.

CHARACTER OF DRIFT

Wisconsinan Deposits

Deposits of the Wisconsinan Glacial Stage (table 1) are the uppermost earth materials in much of Illinois. The most prominent area of Wisconsinan deposits is the ridged plain north of Shelbyville and east of Peoria (fig. 1) that includes about 30 named end moraines. These deposits average 75 to 100 feet thick and attain a maximum of about 250 feet (Horberg, 1953, pl. 1). They consist essentially of tills, with some loess, lake sediments, and outwash. The log of well 1 (Appendix) in Lake County illustrates a fairly typical Wisconsinan sequence in northeastern Illinois.

In contrast to older glacial deposits, the Wisconsinan tills are generally less compact, lighter in color, and have a shallower profile of weathering, with an average depth of leaching of about 3 feet (Horberg, 1953, p. 38). In subsurface, there is less outwash associated with till sheets than in the Illinoian de-

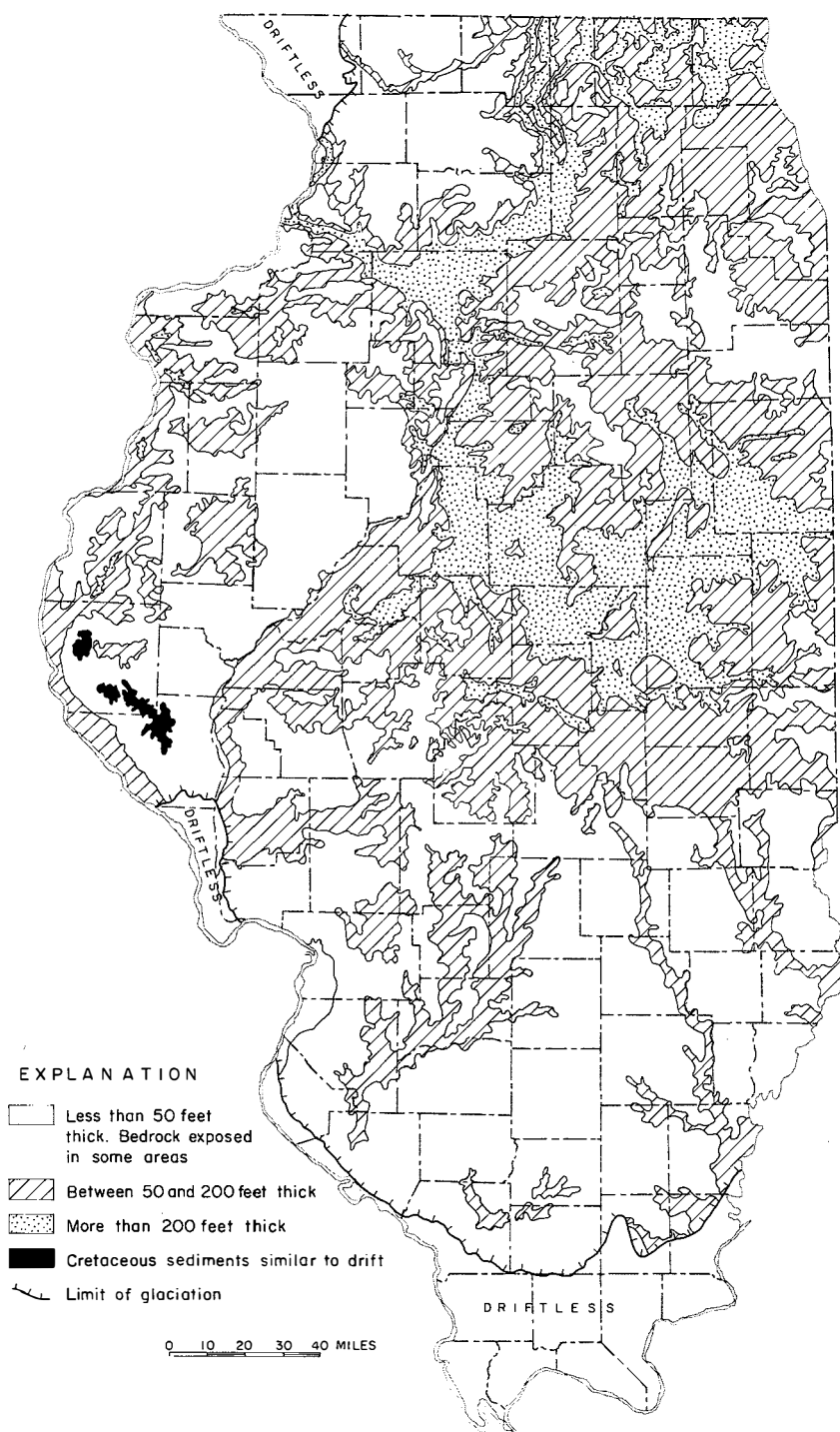


Figure 5 - Generalized drift thickness.

posits. Pebbles constitute 1 or 2 percent to more than 80 percent of the tills and commonly constitute 5 to 10 percent (Krumbein, 1933; Anderson, 1955, 1957). The tills range in texture from sandy and gravelly to clayey (Krumbein, 1933; Willman, Payne, and Voskuil, 1942; Bretz, 1955; Horberg and Potter, 1955; Shaffer, 1956; Kempton, 1963). Data on the physical, chemical, and engineering properties of the surficial deposits of the region are given by Wascher et al. (1960) and Thornburn (1963).

Outwash, ranging from gravel to silt, occurs in valleys that pass through and beyond the Wisconsinan drift border and in outwash plains, in front of moraines. Two of the largest outwash areas, the Green River-lower Rock River basin (Leighton, Ekblaw, and Horberg, 1948, p. 25) and the Havana region of the Illinois River (Walker, Bergstrom, and Walton, 1965), have sand and gravel deposits that are essentially continuous to bedrock (fig. 1; pl. 2), although they contain areas of finer grained Recent alluvium along present streams. The log of well 2 (Appendix) illustrates the sand and gravel sequence near Havana. The Kaskaskia, Little Wabash, and Embarras Rivers (figs. 1 and 4) all contain valley-train deposits that head within the Wisconsinan drift plain and become finer downstream. Horberg (1950) describes the outwash of the valley systems.

Much glaciofluvial sand and gravel are present in the form of outwash plains, valley trains, and kames in McHenry and Kane Counties, in northeastern Illinois (Ekblaw and Lamar, 1964). The deposits here overlie fairly thick till. The occurrence and nature of other surficial and shallow sand and gravel deposits of Wisconsinan age are described in county sand and gravel resource reports and in quadrangle geologic reports. Anderson (1960) described the sand and gravel resources of Champaign County, and in 1964, reported on those of DeKalb County. Block (1960) described sand and gravel resources of Kane County. Anderson and Block (1962) reported on sand and gravel resources of McHenry County. In 1965, Anderson and Hunter described sand and gravel resources of Peoria County, and in 1966, Hunter described those of Tazewell County. In 1923, Bretz reported on geology and mineral resources of the Kings Quadrangle, and in 1939, he described the geology of the Chicago region. Willman, Payne, and Voskuil (1942) described the geology and mineral resources of the Marseilles, Ottawa, and Streator Quadrangles. The Beardstown, Glasford, Havana, and Vermont Quadrangles were covered by Wanless (1957). The geology of the Buda Quadrangle was described by MacClintock and Willman (1959).

The occurrence of deeper outwash of Wisconsinan age and older is described in reports that deal primarily with ground water. Horberg (1950) described the bedrock topography of Illinois and later (1953) the Pleistocene deposits below the Wisconsinan drift in northeastern Illinois. Bergstrom et al. (1955) described ground-water possibilities in northeastern Illinois, and Suter et al. (1959) described ground-water resources of the Chicago region. Hackett and Bergstrom (1956) reported on ground water in northwestern Illinois, Selkregg and Kempton (1958) in east-central Illinois, Bergstrom (1956) and Bergstrom and Zeizel (1957) in western Illinois, Selkregg, Pryor, and Kempton (1957) in south-central Illinois, and Pryor (1956a) in southern Illinois. Ground-water resources of DuPage County were described by Zeizel et al. (1962). Foster (1956) described the ground-water geology of Lee and Whiteside Counties. Hackett (1960) reported on Winnebago County, and the ground-water geology of White County was described by Pryor (1956b). Walker, Bergstrom, and Walton (1965) described ground-water resources of the Havana region. The East St. Louis area was described by Bergstrom and Walker (1956). Horberg, Su-

ter, and Larson (1950) described ground water in the Peoria region, and Foster and Buhle (1951) investigated aquifers in glacial drift near Champaign-Urbana.

Wisconsinan loess is widespread in Illinois and constitutes the parent materials of the modern soils in much of the state. Where viewed in road cuts or river bluffs, it usually appears as massive yellowish to reddish brown silt that stands in steep vertical faces. It is thickest and coarsest on the lee sides of the Mississippi, Illinois, Green, and Ohio Rivers (fig. 1; Smith, 1942, fig. 3), especially adjacent to wide stretches of valley flat. For example, east of the wide American Bottoms at East St. Louis the loess is about 70 feet thick, and in Cass County, adjacent to the broad valley at Havana, the loess in a few places is more than 90 feet thick. The loess decreases rapidly in thickness and coarseness within 2 or 3 miles of the river bluffs, then thins and gradually becomes finer grained. In much of Illinois, the loess is only a few feet thick. Along the river bluffs, where the loess is thick, it is commonly calcareous and contains small fossil snail shells. Away from the valley, where the loess thins, it is usually leached and unfossiliferous.

The loess consists of a distinct succession of deposits that have been intensively studied (Smith, 1942; Leighton and Willman, 1950; Frye and Willman, 1960; Leonard and Frye, 1960; and Frye, Glass, and Willman, 1962).

Illinoian Deposits

Illinoian deposits, with a cover of Wisconsinan loess varying in thickness, extend into southern Illinois about 8 to 10 miles south of Carbondale and into western Illinois approximately to the Mississippi River (fig. 1). Illinoian drift has been traced beneath the Wisconsinan drift of northeastern Illinois for many miles (Horberg, 1953, p. 26).

The Illinoian drift has three moraines in the western part of the state (fig. 1) but has no continuous end moraine at its border. The Illinoian is characterized by a relatively high proportion of outwash and by hard, silty, brownish gray or dark gray tills. The log of well 3 (Appendix) in Montgomery County illustrates the nature of the Illinoian drift.

At the top of the Illinoian till the intensely weathered zone is as much as 6 feet thick with an average of about 2 feet. The till is leached to a depth of 5 to 12 feet with an average of about 8 feet, and the oxidized zone extends down to 12 to 15 feet below the surface (Horberg, 1953, p. 28). A very clayey deposit, called accretion-gley, that accumulated in low places on the till plain is common in many areas. Where Wisconsinan and Illinoian tills can be compared in one exposure, the Illinoian till is much more compact and jointed. Beds of sand and gravel are common at the base, in the middle, and at the top of the Illinoian deposits.

Data on the texture and mineralogy of the Illinoian tills are given by Horberg (1956); Frye, Willman, and Glass (1960); and Willman, Glass, and Frye (1963, 1966). Descriptions of the Illinoian deposits in various areas of Illinois are given by Horberg, Suter, and Larson (1950); Foster and Buhle (1951); Pryor (1956a); Wanless (1957); and Johnson (1964).

Pre-Illinoian Deposits

Pre-Illinoian deposits are irregularly distributed in Illinois. Their extent is not well known, and, where present, they are usually overlain by younger drift.

Only in western Hancock, Adams, and Pike Counties, does the older drift—the Kansan—emerge from beneath the outer edge of the Illinoian (fig. 1).

The older drifts are usually identified by their weathered zones at the top and their occurrence below the Illinoian drift. They are commonly dark colored, oxidized, dense, and frequently contain wood fragments and peaty material. The mineralogy of the pre-Illinoian drifts has been studied by Willman, Glass, and Frye (1963), and areal descriptions of the Kansan deposits are given by Horberg (1956), Wanless (1957), and Johnson (1964).

In the Champaign-Urbana area, and extensively along the Mahomet Bedrock Valley, the Kansan deposits consist of yellow-brown to gray, pebbly, silty till underlain by thick beds of sand and gravel that extend to bedrock. The thickness of the sand and gravel ranges up to about 150 feet (Foster and Buhle, 1951, p. 381-383). Horberg (1953, p. 18) applied the name Mahomet Sand to the thick sand and gravel beds overlying bedrock in the Mahomet Bedrock Valley (pl. 2) and considered them similar in age and origin to the Sankoty Sand of the Ancient Mississippi Valley. The log of well 4 (Appendix) illustrates the nature of the Mahomet Sand, with overlying Illinoian and Wisconsinan deposits, in the Mahomet Valley in Champaign County.

The Sankoty Sand (Horberg, 1950, p. 34-36) is a continuous fill along the Ancient Mississippi Valley (pl. 2) and has been recognized in cuttings from wells as far south as Havana and as far north as Prophetstown in southern Whiteside County (Horberg, 1953, p. 13-18). The texture is commonly medium grained, but the deposits range from fine-grained silty sand to coarse-grained gravelly beds. The thickness of the sand varies greatly; the maximum thickness may be almost 300 feet, although the average thickness is closer to 100 feet. The position and nature of the Sankoty Sand in Mason and Bureau Counties are illustrated in logs 4 and 5 (Appendix).

The Sankoty and Mahomet Sands are economically the most important Kansan deposits, for they constitute one of the most prolific aquifer systems in Illinois, providing water for many towns and industries in a part of the state where no other highly permeable aquifers are present.

The Nebraskan glacier invaded western Illinois, but its deposits have been so extensively eroded that the area it covered is highly indefinite. Nebraskan deposits probably constitute an insignificant part of the drift mantle of Illinois.

Some sand, gravel, and clay deposits up to 100 feet thick in Adams and Pike Counties, east of Quincy (fig. 5), have recently been interpreted as Cretaceous in age (Frye, Willman, and Glass, 1964) rather than Pleistocene and Tertiary, as originally mapped. They differ markedly in mineralogy from the glacial deposits.

CONCLUSIONS

The thickness and character of the drift have practical implications for individual, industrial, and administrative interests in the state. This report has summarized the main features of the drift. It has shown that the drift includes many kinds of earth materials and varies in character and thickness from place to place. Geologically speaking, these materials are relatively young and were formed under continental conditions, as opposed to the layered (and usually cemented or consolidated) bedrock that underlies the drift, that is many millions of

years older than the drift, and that was formed from sediments deposited in or close to the sea. Shale is part of the bedrock, not the drift.

The drift is thin and the bedrock is widely exposed in southern and western Illinois and part of northeastern Illinois adjacent to the Illinois, Des Plaines, and Kankakee Rivers. These areas may be of special interest to industries that quarry limestone, sandstone, or shale, or that mine coal. The geologic map of Illinois shows the nature of bedrock.

Public health officials have different interests in the thickness and nature of the drift and the kind of bedrock directly below. For example, where limestone or dolomite are the uppermost bedrock, crop out extensively, and are only partly covered by thin drift, there are opportunities for pollutants to enter the ground-water reservoir and travel for considerable distances through joints and channels. Furthermore, burial of wastes in these areas introduces the danger of pollution.

Thin drift and extensive rock outcrop, as opposed to thick drift, create particular problems in highway and building location and construction. Drift thickness is also of interest to the drilling industry, particularly with regard to setting surface casing.

The drift is thickest in the present major river valleys, in buried bedrock valleys, and regionally in the northeastern quarter of Illinois that was covered by the Wisconsin glacier. The drift is more than 200 feet thick in some of the major valleys and beneath some of the moraines and attains a maximum thickness of some 600 feet in the Pawpaw Bedrock Valley in southeastern Lee County.

The areas of thicker drift, which are commonly situated along valleys where glacial meltwater deposited sand and gravel, are the most favorable areas for developing ground-water supplies. In most of the southern two-thirds of the state, where the bedrock yields only modest supplies of ground water, the drift in bedrock valleys is the only source of large supplies, such as for municipalities, industries, and irrigation.

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APPENDIX

Logs of Representative Wells

1. Austin (Deep Freeze), 1951, SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 18, T. 44 N., R. 12 E., Lake County. Elevation E.T.M.* 678 feet. Sample set no. 21463. Studied by P. M. Busch.

	Thickness (ft)	Depth to base (ft)
Pleistocene Series		
Wisconsinan Stage		
Soil, sandy, black, organic fragments	5.0	5.0
Till, clayey, yellowish orange	5.0	10.0
Till, calcareous, dark grayish pink	30.0	40.0
Till, calcareous, sandy, dark yellowish gray	25.0	65.0
Sand, fine-grained gravel, dolomitic, gray	35.0	100.0
Sand and gravel, clayey, silty, dolomitic, yellowish gray	5.0	105.0
Sand and gravel, dolomitic, yellowish gray	30.0	135.0
Gravel to $\frac{1}{2}$ " and little sand, dolomitic, gray	10.0	145.0
Till, calcareous, dark grayish pink	5.0	150.0
Till, calcareous, silty, yellowish gray	15.0	165.0
Till, calcareous, gravelly, silty, yellowish gray	5.0	170.0
Gravel and sand, clayey, silty, gray	5.0	175.0
Bedrock, dolomite		

Driller's log of Austin well.

Sand, gravel, clay	185.0	185.0
Limestone		

2. Stelter, Julius, farm, 1959, cen. line NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 28, T. 21 N., R. 8 W., Mason County. Elevation E.T.M. 495 feet. Sample set no. 35414. Studied by R. E. Bergstrom.

*Estimated from topographic map.

	Thickness (ft)	Depth to base (ft)
Pleistocene Series		
No samples	18.0	18.0
Wisconsinan Stage (Bloomington out-wash)		
Sand, fine to medium grained; yellowish brown subangular grains; ferruginous staining; abundant yellowish quartz grains; some brown silt	8.0	26.0
Sand, medium grained, as above; some granular gravel	10.0	36.0
Silt, brown, calcareous	2.0	38.0
Sand, medium grained; yellowish brown subangular grains	4.0	42.0
Sand, medium to coarse grained with granular gravel, yellowish brown; granules of dolomite, quartz, and granite	12.0	54.0
Sand, fine to coarse grained, some very coarse grained, yellowish brown; abundant grains of yellowish quartz and feldspar	12.0	66.0
Kansan Stage		
Sankoty Sand		
Sand, medium to coarse grained, pinkish gray; subangular to rounded grains; abundant pink and pink stained quartz grains; some granular gravel and fine-grained sand beds	22.0	88.0
Sand, fine to very coarse grained, pinkish gray; abundant pink grains; some granules of dolomite, quartz, feldspar, and igneous rocks	10.0	98.0
Sand, fine to medium grained, reddish brown, subangular; abundant pink grains; many grains with pink clay skins	8.0	106.0
Sand, medium to very coarse grained, pinkish gray; pink grains; granules of chert, dolomite, and dark igneous rock	12.0	118.0
Gravel, granular, with very coarse-grained sand; granules of dolomite, granite, sandstone, felsite, and dark igneous rock	4.0	122.0 (Total depth)

Driller's log of Stelter well.

	Thickness (ft)	Depth to base (ft)
Top stratus	22.0	22.0
Fine-grained sand	8.0	30.0
Medium-grained sand	4.0	34.0
Mud	2.0	36.0
Medium-grained sand	4.0	40.0
Mud	2.0	42.0
Sand and gravel	24.0	66.0
Medium-grained sand	6.0	72.0
Medium-grained sand	6.0	78.0
Good sand and some gravel	2.0	80.0
Fine-grained sand	6.0	86.0
Medium-grained sand	6.0	92.0
Coarse-grained gravel and some cobbles	6.0	98.0
Sand	4.0	102.0
Sand	2.0	104.0
Medium-grained sand and some stones	4.0	108.0
Good gravel	5.0	113.0
Mostly sand, some gravel	3.0	116.0
Good sand and gravel	6.0	122.0
		(Total depth)

3. Held, Joe, 1954, SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T. 10 N., R. 4 W., Montgomery County. Elevation E.T.M. 636 feet. Sample set no. 24625. Studied by E. Atherton.

Pleistocene Series

Illinoian Stage

Till, noncalcareous, very silty, light brown	15.0	15.0
Gravel, fine to medium grained; till, calcareous, orange	5.0	20.0
Till, calcareous, brownish gray	10.0	30.0
Bedrock, shale		

Driller's log of Held well.

Surface soil	5.0	5.0
Clay	25.0	30.0
Shale and gravel		

4. Illinois Water Service Co. No. 38, 1950, 20 feet N. of cen. of S. line sec. 36, T. 20 N., R. 7 E., Champaign County. Elevation E.T.M. 715 feet. Sample set no. 20601. Studied by J. W. Foster.

	Thickness (ft)	Depth to base (ft)
Pleistocene Series		
Wisconsinan Stage		
Soil, dark brown, and till, yellow, clayey, noncalcareous	10.0	10.0
Till, yellow-buff, clayey, calcareous	10.0	20.0
Till, gray-buff, silty, calcareous, some sand	20.0	40.0
Soil, black over till, yellow, noncalcareous	10.0	50.0
Till, gray-buff, and scattered soil (possibly cave), calcareous	5.0	55.0
Till, pinkish, silty, calcareous, and soil, as above	5.0	60.0
Till, pinkish, silty, with sand and gravel	15.0	75.0
Till, pinkish, silty, sandy, with scattered soil	5.0	80.0
Illinoian Stage		
Till, buff and weathered, noncalcareous, and soil, black	5.0	85.0
Till, buff and yellow, partly calcareous, calcareous below	15.0	100.0
Till, as above, very sandy	20.0	120.0
Till, as above, with light brown soil fragments	5.0	125.0
Till, yellow-buff, sandy, calcareous, scattered black soil	10.0	135.0
Till, gray-buff, sandy and gravelly, pinkish below, calcareous	55.0	190.0
Till, as above, with strong soil show	15.0	205.0
Kansan Stage		
Till, yellow, oxidized, noncalcareous, and soil, black	5.0	210.0
Till, buff, sandy, gravelly, calcareous	10.0	220.0
Mahomet Sand		
Sand, yellow, very coarse grained, very dirty, with fine-grained gravel below	35.0	255.0
Gravel, fine to medium grained, very dirty, calcareous	10.0	265.0

	Thickness (ft)	Depth to base (ft)
Pleistocene Series (continued)		
Gravel, fine grained, very dirty, with silt interbedding	5.0	270.0
Gravel, fine to medium grained, dirty, scattered soil below	15.0	285.0
Gravel, fine grained, very dirty, soil fragments	5.0	290.0
Gravel, medium grained, dirty, with fill interbedding, calcareous	15.0	305.0
Gravel, fine to medium grained, poorly sorted, dirty with till frag- ments and probable Pennsylvanian sandstone chips; bedrock surface not positive from sample study	2.0	307.0
		(Total depth)

5. Doty, S. L., 1935-1938, SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 17 N., R. 6 E., Bureau County. Elevation E.T.M. 620 feet. Sample set no. 1619. Studied by L. Horberg.

Pleistocene Series

Wisconsinan Stage

Sand, medium grained, slightly cal-
careous, clean, buff, largely an-
gular quartz

48.0 48.0

Kansan Stage

Sankoty Sand

Sand, fine to coarse grained, slight-
ly silty, humus trace

4.0 52.0

Granular gravel, with some sand,
fine to medium grained, polished

6.0 58.0

Sand, coarse grained, gravelly, cal-
careous, humus abundant

8.0 66.0

Silt, loesslike, calcareous, yellow-
gray, spores, wood fragments

4.0 70.0

Sand, coarse to very coarse grained,
calcareous, numerous polished and
frosted grains

2.0 72.0

Silt, calcareous, loesslike, yellow-
ish gray spores and wood fragments

14.0 86.0

Sand, some gravel, medium to coarse
grained, humus stained

132.0 218.0

Bedrock, dolomite

Driller's log of Doty well.

	Thickness (ft)	Depth to base (ft)
Sand, yellow	48.0	48.0
Sand and gravel	10.0	58.0
Sand, gravel, dirty	8.0	66.0
Silt and clay	2.0	68.0
Sand and gravel	2.0	70.0
Sand, medium grained	42.0	112.0
Sand, granular, buff, red, black	41.0	153.0
Sand, buff, red, coarse grained, polished	20.0	173.0
Sand, granular, buff, red, black	7.0	180.0
Gravel, buff, red, black, fine to medium grained	10.0	190.0
Sand, scattered, granular	20.0	210.0
Gravel, sand	8.0	218.0
Dolomite		

6. West Brooklyn Village No. 3, 1948, SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 37 N.,
R. 1 E., Lee County. Elevation E.T.M. 980 feet. Sample set no. 17800.
Studied by M. P. Meyer; modified by J. W. Foster.

Pleistocene Series

Wisconsinan Stage

Till, brown, grading to sandy	109.0	109.0
Sand, coarse grained, and gravel, clayey	22.0	131.0
Sand, fine to medium grained, clayey	9.0	140.0
Till, brown, with gray, lower part	146.0	286.0

Illinoian Stage

Till, greenish, partly noncalcareous	7.0	293.0
Till, gray, calcareous	28.0	321.0
Sand and gravel, silty and clayey, generally cleaner near base	105.0	426.0

Pre-Illinoian Stage

Humus on noncalcareous clay, with sand and gravel below	21.0	447.0
Till, gray, very sandy, gravelly, calcareous	19.0	466.0
Sand, medium to very coarse grained, slightly silty	18.0	484.0
Till, yellow and gray, noncalcare- ous, with thin sand and gravel low- er part	6.0	490.0

Bedrock, sandstone

Driller's log of West Brooklyn No. 3 well.

	Thickness (ft)	Depth to base (ft)
Top soil	3.0	3.0
Clay, yellow	2.0	5.0
Clay, brown	7.0	12.0
Clay and stones, red	77.0	89.0
Sand and clay	6.0	95.0
Clay, sand and stones, red	14.0	109.0
Sand and gravel, dirty	11.0	120.0
Sand, clay and stones, red	20.0	140.0
Clay and stones, red	14.0	154.0
Clay, red	7.0	161.0
Clay, sand and stones, red	97.0	258.0
Clay, sand and stones, blue	21.0	279.0
Clay, sand and stones, blue, hard	21.0	300.0
Clay, sand and stones, blue	14.0	314.0
Stones, clay and sand, hard	14.0	328.0
Sand, clay and stones, water bearing	7.0	335.0
Sand, clay and stones	7.0	342.0
Sand, clay and stones	7.0	349.0
Sand, clay and gravel	14.0	363.0
Sand, gravel, clay	28.0	391.0
Sand, clay and stones	7.0	398.0
Clay, sand and stones	7.0	405.0
Sand, clay and stones	12.0	417.0
Sand and gravel	3.0	420.0
Sand, clay and stones	6.0	426.0
Clay, brown, hard	6.0	432.0
Sand, dirty	3.0	435.0
Clay, sand and stones	26.0	461.0
Sand, clay and stones	5.0	466.0
Sand, dirty	18.0	484.0
Clay, hard	3.0	487.0
Sand and gravels	2.5	489.5
Sand rock, hard		

7. Northeastern Illinois Metropolitan Area Planning Commission Test Hole No. 1, 1962, SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T. 46 N., R. 5 E., McHenry County. Elevation E.T.M. 975 feet. Core No. 4515. Logged by K. Swanson (Layne-Western Co.).

Pleistocene Series

Wisconsinan Stage

Clay, silty, gray, mottled	5.0	5.0
Till, yellowish red-brown to gray silty sand and sandy silt	83.0	88.0

	Thickness (ft)	Depth to base (ft)
Pleistocene Series (continued)		
Sand and gravel, gray; few silty layers	25.0	113.0
Sand, silty, gray-brown; trace clay	13.0	126.0
Silt, clayey, gray; few speckled seams of very fine-grained sand	50.0	176.0
Till, gray-brown clayey silt; few sand and silt seams	24.0	210.0
Silt, dark brown; trace sand and fine-grained gravel	26.0	236.0
Sand, brown-pink; few gravels; trace of silt and clay	40.0	276.0
Till, pink-brown sandy silt; trace of gravel and clay	74.0	350.0
Sand, silty, dark gray; trace of clay and gravel	4.0	354.0
Gravel, sandy, coarse grained, poorly sorted	36.0	390.0
Silt, gray-buff; small lenses of sand	12.0	402.0
Gravel, sandy, coarse grained; trace silt	4.0	406.0
Silt, brown; trace of clay	6.0	412.0
Gravel, gray-brown, some sand; little clay and silt	46.0	458.0
Silt, hard, gray-brown; trace of very fine-grained sand	12.0	470.0
Till; medium brown hard clay, silt, sand	3.5	473.5
Bedrock, dolomite, gray-brown		(Total depth)

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